MULTIMEDIA ⏻ UNIVERSITY
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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2017/2018

ETM7126 – SATTELITE COMMUNICATIONS

31 MAY 2018
2:00 P.M- 5:00 P.M
(3 Hours)

INSTRUCTION TO STUDENTS

1. This examination paper consists of 7 pages including cover page with 4 Questions only.

2. Attempt **ALL** the questions. Each question carry equal marks and distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided. Please number your answers clearly.

Question 1

(a) Provide FIVE (5) reasons why Geosynchronous Orbit is important for satellite communications.

[5 marks]

(b) List out THREE(3) satellite orbit parameters.

[3 marks]

(c) Differentiate between solar day time and sidereal day time also critically analyze their differences.

[4 marks]

(d) An earth station situated in the Docklands of London, England needs to calculate the look angle to a geostationary satellite in the Indian Ocean operated by Intelsat. The details of the earth station site and the satellite are as follows:

Earth station latitude and longitude are 52.0° and 0°, respectively.
Satellite latitude and longitude (subsatellite point) are 0° and 66°.

Determine the following:
(i) Central angle

[3 marks]

(ii) Elevation angle

[3 marks]

(iii) Intermediate angle

[2 marks]

(e) Given that the sidereal day time is 23 hours 56 minutes 4.1 seconds, calculate the radius and height of the geostationary orbit (GEO) satellite.

[5 marks]

Continued.......

Question 2

(a)　In cross polarization, there are imperfections of antenna and possible depolarisation of the waves by the transmission medium. Provide THREE(3) examples of cross polarization scenarios.

[6 marks]

(b)　Provide a reason why isotropic antenna is used as reference antenna.

[3 marks]

(c)　Differentiate between the model used in Geocentric satellite orbit and the model used in Geographical satellite orbit.

[4 marks]

(d)　A satellite circuit has the parameters shown in Table 2(d), calculate the overall carrier to noise ratio, C/N_o value in dBHz.　　　　　　　　　　[5 marks]

Table 2(d)

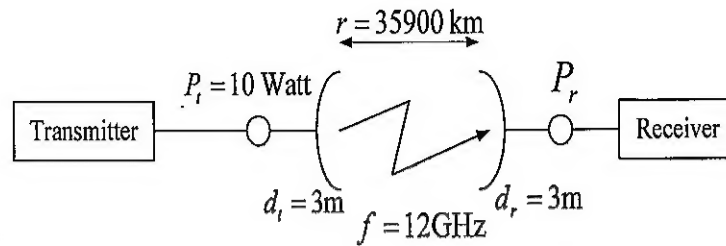|	Uplink , (decilogs unit)	Downlink, (decilogs unit)
Effective Isotropic Radiated Power (EIRP)	54	34
Gain/Temperature (G/T)	0	17
Free Space Loss (FSL)	200	198
Radio Frequency Loss (RFL)	2	2
Attenuation (AA)	0.5	0.5
Loss (AML)	0.5	0.5

(e)

Figure 2(e)

Consider a satellite uplink with the parameters shown in Figure 2(e). The transmitted power is 10 watts, and both the transmitter and receiver parabolic antennas have a diameter of 3 m. The antenna efficiency is 55% for both antennas. The satellite is in a geostationary satellite orbit (GSO) location with a range of 35 900 km. The frequency of operation is 12 GHz. Determine the following:

(i)　Antenna gain　　　　　　　　　　　　　　　　　　　　　　　　　　[3 marks]

(ii)　Effective isotropic radiated power (EIRP)　　　　　　　　　　　　　[1 mark]

(iii)　Free space loss　　　　　　　　　　　　　　　　　　　　　　　　[1 mark]

(iv)　Received power　　　　　　　　　　　　　　　　　　　　　　　　[2 marks]

Continued.......

Question 3

(a) Describe about Intermodulation or Intermodulation Distortion (IMD).

[4 marks]

(b) Provide TWO(2) applications of Demand Assignment Multiple Access (DAMA).

[4 marks]

(c) Figure 3(c) shows the state of pure Aloha protocol of random access scheme where the transmit station is acknowledged through acknowledgement (ACK) packet received from the receiving station. Modify the diagram if there is no packet received from the receiving station.
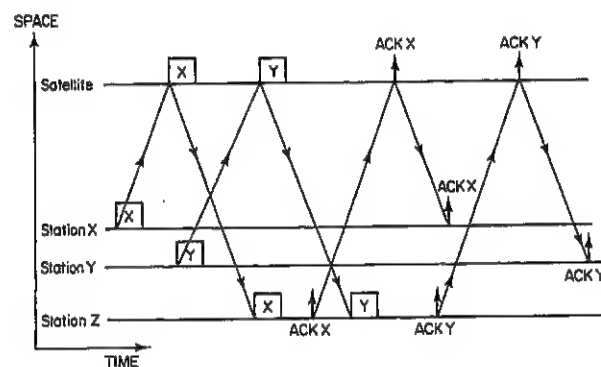

Figure 3(c)

[3 marks]

(d) In a speech signal, the lowest frequency is 300 Hz and the highest frequency, f_m is 3.4 kHz. Consider a Single Channel Per Carrier - Frequency Modulation - Frequency Division Multiple Access (SCPC-FM-FDMA) system with a specific Channel Signal to Noise Ratio (SNR) of 33 dB. Let the test tone peak frequency deviation be $\Delta f = 9.1$ kHz. Determine:

(i) the bandwidth of the SCPC-FM-FDMA system.

[3 marks]

(ii) the carrier-to-noise ratio of the SCPC-FM-FDMA system.

[4 marks]

Continued.......

(e)   Consider a 70-channel frequency duplex muliplexing (FDM) system with a maximum baseband frequency of 252 kHz and a specified top channel signal to noise ratio (SNR) of 50 dB. Assume that FDM multichannel root mean square (rms) frequency deviation of $\mathit{lf_r} = 500$ kHz is employed.

Determine:

(i)   the bandwidth of the FDM-FM-FDMA carrier using Carson's Rule.

[2 marks]

(ii)   the FDM multichannel loading factor of $n=70$ channels.

[2 marks]

(iii) the 0 dBm test tone rms frequency deviation.

[1 mark]

(iv) the carrier to noise ratio of the FDM-FM-FDMA system in dB. Assume channel bandwidth of 3.1 kHz and power of 6.5 dB are used.

[2 marks]

Question 4

(a) Describe about satellite interconnection by beam scanning and draw a related diagram.

[7 marks]

(b) Explain TWO(2) topologies of network configuration in a very small aperture antenna (VSAT).

[4 marks]

(c) Figure 4(c) shows the interference in the downlink of multibeam satellite networks where the Beam 1 earth station receives the carrier at frequency f_{D1} emitted with maximum gain in the antenna lobe defining beam 1. From the diagram, explain how co-channel interference and adjacent channel interference occurs.
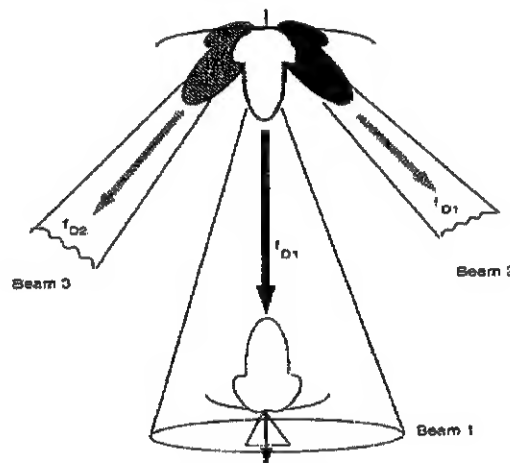

Figure 4(c)

[5 marks]

(d) Consider a multibeam satellite system with M spot beams. The total bandwidth B is divided into 3 subbands. Subband#1 is used for 6 times, subband#2 is used for 4 times, and subband#3 is used for 3 times. Calculate:

(i) the re-use factor if no orthogonal polarisation is used.

[2 marks]

(ii) the re-use factor if orthogonal polarisation is used.

[2 marks]

(e) Describe the links between Geostationary and Low Earth Orbit satellites (GEO-LEO). Draw a diagram to support your answer.

[5 marks]

End of Paper